XVI. *Observations and experiments on the mass of native iron found in Brasil.* *By* W. H. Wollaston, *M. D. Sec. R. S.*

Read May 16, 1816.

THE preceding letter from Mr. MORNAY, relating to the discovery of a mass of native iron in Bahia, was drawn up at my request, as a valuable addition to our stock of knowledge on that most curious subject; and I am in hopes that the results of my own experiments may contribute something not uninteresting to the Society.

The specimen of the iron with which Mr. MORNAY very liberally supplied me for experiment, though it necessarily bears marks of the hammer by which it has been detached, presents also other surfaces, not only indicating that its texture is crystalline, but showing also the forms in which it is disposed to break, to be those of the regular octohedron and tetrahedron, or rhomboid, consisting of these forms combined.

In my own specimen, the crystalline surfaces appear to have been the result of a process of oxidation, which has penetrated the mass to a considerable depth in the direction of its laminæ; but in the specimen which is in the possession of the Geological Society, the brilliant surfaces that have been occasioned by forcible separation from the original mass, exhibit also the same configurations, as are usual in the fracture of octohedral crystals, and are found in many simple native metals.

The magnetic qualities of the fragments, fortunately,

enable us to appreciate rightly, those of the entire mass from which they have been detached; for though the mass, when tried upon the spot by Mr. MORNAY, gave indications of having distinct N. and S. poles, it is pretty clear that these were only so by induction, in consequence of position with respect to the magnetic meridian. For though the fragments are not in the least attractive as magnets, and have in themselves no polarity, they are precisely like any other pieces of the best soft iron, and assume polarity instantly, according to the position in which they are held with respect to the magnetic axis of the earth. When a long fragment is held in a vertical position, its lower extremity being then within 20° of the dip of the N. magnetic pole, becomes N., and repels the N. pole of a magnetic needle suspended horizontally. But this power is instantly reversed by being suddenly inverted. So that the apparent contradiction between the observed polarity of the mass, and the seeming want of it in the fragments, is thus completely removed.

Although Mr. MORNAY reasonably expected that this iron would not differ from the many others now on record that have been found in various parts of the world, and from his experiments was led to infer the presence of nickel, it appeared desirable to ascertain this point with more precision than he had been enabled to do, and to determine also in what proportion this peculiar ingredient of meteoric bodies might be found to prevail.

I believe the means which I am accustomed to employ for detecting the *presence* of nickel in native iron to be new, and may deserve to be described, on account of the very small quantity of the iron required for this mode of examination.

Having filed from my specimen as much as I judged sufficient for my purpose, (which need not exceed $\frac{1}{100}$ of a grain), I dissolved it in a drop of nitric acid, and then evaporated the solution to dryness. A drop or two of pure ammonia was then added to the dried residuum, and gently warmed upon it in order to dissolve any nickel that might be present. The transparent part of the fluid was then led by the end of a rod of glass to a small distance from the remaining oxide of iron, and the addition of triple prussiate of potash immediately detected the presence of nickel by the appearance of a milky cloud, which was not discernible by the same means from a similar quantity of common wrought iron tried at the same time.

For the determination of the *quantity* of nickel I employed a different method. A piece of the iron weighing 50 grains having been dissolved in nitro-muriatic acid, the solution was evaporated to dryness. Ammonia was then added, and the solution again evaporated to dryness, in order that the oxide of iron might be rendered more dense, and more easily separated from the soluble portion. A fresh addition of ammonia then readily dissolved the nickel, and the solution after filtration appeared of a deep blue colour.

A small quantity of sulphuric acid having then been added, the whole was again evaporated not merely to dryness, but with sufficient heat to expel the excess of ammonia, muriate of ammonia, and sulphate of ammonia. The remainder was sulphate of nickel which was then redissolved in water, and after being suffered to crystallize weighed 8,6 grains. Having found by experiment previously made for that purpose,

that 10 grains of nickel give 44 grains of sulphate of nickel, I infer that 8,6 of the sulphate correspond to 1,95 of metallic nickel, which is nearly 4 per cent of the quantity of native iron taken for experiment.

By an analysis conducted in a similar manner on 23 grains of the scaly flakes of oxide brought home by Mr. MORNAY, from the spot were the mass was found, I obtained 3,1 grains of sulphate of nickel, which correspond to 7,05 nickel, amounting to no more than 3,06 per cent. of the oxidated crust taken for analysis. But, if we consider the weight which 100 parts of the metallic alloy would acquire by oxidation, we shall find the two experiments correspond with a degree of accuracy that may occasion more reliance to be placed on these experiments than they really deserve.

96 parts of iron in the state of black oxide will be combined with 28,3 oxygen
and 4 nickel will take
about 1.1 oxygen,

so that 129,4 of the crust will contain only 4 parts of metallic nickel, and 100 ditto will contain 3,1, which scarcely exceeds the quantity actually found by trial.

From the presence of nickel in this mass we cannot but regard it as having the same meteoric origin with the various other specimens that have before been found; and although in the spot whence it had been first removed, Mr. MORNAY discovered a bed of matter from which it appears, by analysis, that similar iron might be formed by art, it seems by far more probable, that an opposite change has really taken place, and that the whole of this supposed ore is the result of pro-

gressive oxidation, during a series of years of which we have no other evidence, and affords the sole ground on which a conjecture could be formed of the very remote period at which this problematic body has fallen upon the earth.